

Keyser (P. D.) REPORT

OF AN

EXAMINATION OF RAILROAD MEN

FOR

COLOR BLINDNESS,

Read before the Pennsylvania State Medical Society,
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BY



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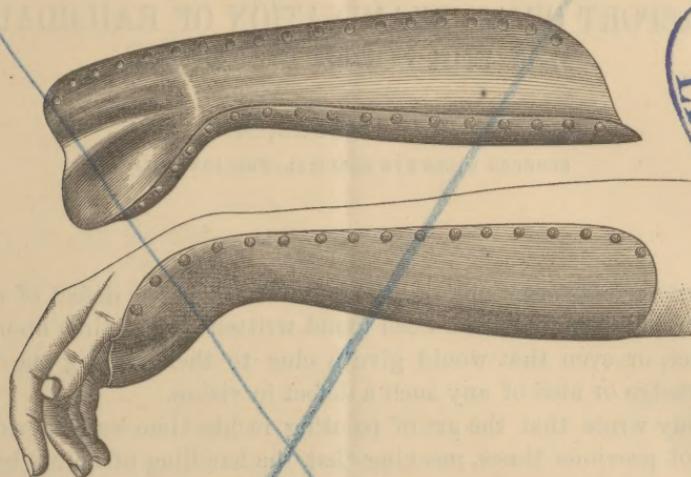
EXTRACTED FROM THE TRANSACTIONS OF THE PENNSYLVANIA
STATE MEDICAL SOCIETY.

1879.

Compliments of

the Author.

With the object of retaining the apposition of the fractured surfaces, by overcoming displacing forces, I have practised for many years on the principles involved in the splint here illustrated, the application of which will not require much description.



In the treatment of fracture of the lower end of the radius it is essential that proper allowance be made for the curvature of the anterior or palmar surface of this part of the bone. This is insured in the splint which I have devised, which follows correctly the radial curvature; and the fixing of the thenar and hypothenar eminences of the hand in their moulded beds, maintains the splint immovably in its correct position with reference to the radial curve.

The splint is made of copper, so as to be readily conformable by bending to suit the peculiarities of size and form of forearms. The series of little pointed elevations along the edge is for the purpose of keeping the bandage from slipping. It is tinned to prevent oxidation.

The splint will usually fit the forearm so accurately that but little padding will be required, and a piece of woven lint or of cotton or woollen flannel is all that is necessary for its lining. No dorsal splint is needed, but as before referred to, a small pad will, in most cases be required over the dorsal surface of the lower fragment. For retention of the splint an ordinary bandage, two inches and a half to three inches wide, is all that is necessary.

This splint has the merits of being applicable to all cases of fracture of the lower end of the radius, and also to many other injuries involving the forearm and wrist; it is almost indestructible, and, as now supplied, is very inexpensive. It may be obtained by addressing any of the leading surgical instrument makers.

REPORT OF AN EXAMINATION OF RAILROAD MEN FOR COLOR BLINDNESS.

BY P. D. KEYSER, M.D.,

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THE ancients seem not to have been aware of the defect of color blindness, as nothing has been found written at that time upon the subject, or even that would give a clue to their having the least knowledge or idea of any such a defect in vision.

Pliny wrote that the art of painting in his time was inferior to that of previous times, meaning that the handling of colors by the painters, in their pictures, was not as skilful, elaborate, and fine as in those of earlier date, but says nothing about any defect in the perception of colors.

Really no note seems to have been made of this anomaly until 1830, when Dalton, who had discovered his inability to distinguish red from green, published an account thereof.

There is no doubt that this defect has always existed among the inhabitants of the earth, in some greater or less extent, but as the compositions and effects of colors were not studied at that time, no notice was taken of it by the learned men of those early days.

Even after Dalton's publication of his observations on the anomalies of the perception of colors, and the description of his own defect, no great note thereof was taken except to classify it as one of the very rare forms of anomalies in vision. No attempt was made to examine the mass of the people to see to what extent it could be found. Only within the past few years has attention been drawn to it and interest taken therein by the simple discovery on investigating the causes of some railroad accidents, that the engineers did not or could not distinguish the signals of danger that were displayed. This, as might be said, "opened the eyes" of the physiologists, ophthalmologists, and other scientific men, and general examinations of all train hands as well as school children have been and are being made throughout the different countries in Europe at the present day.

Ever since the establishment of railroads there have been unaccountable accidents. The switches have been found in their proper places, the signals correctly displayed, but still trains have run one in the other, telescoped as it is called in railroad parlance; run into all sorts of dangerous places, etc., when signals were out. At last the eyes of some of the officials became opened while making thorough investigations of some unaccountable accident in Sweden; it was discovered that the engineer did not recognize the danger signals that were displayed and passed on as if all were right and the way clear; thus causing the accident that had occurred. From this knowledge it was determined to have the hands on the road examined with the signals, and to their surprise it was found that quite a number could not distinguish the colors, mistaking red for green and *vice versa*.

Examinations have now been made throughout Europe, of all the railroad employés, with the astonishing discovery of from 2 to 10 per cent. color blind among them.

The government of Sweden and Norway was the first to take an active interest in this matter, and placed it in the hands of Prof. Holmgren, of Upsala, to investigate. He has made careful examinations of the school children in the higher and lower schools, railroad employés, sailors, soldiers, factory hands, and prisoners, with the following results: Public schools 4.54 per cent. Elementary schools 3.45 per cent. Students 3.08 per cent. Young people of different positions and conditions 4.50 per cent. Railroad hands 2.15 per cent. Sailors 2.22 per cent. Soldiers 3.54 per cent. Factory hands 4.77 per cent. Prisoners 5.60 per cent.

Prof. Donders, of Utrecht, examined the railroad hands in Holland and found 6.60 per cent. color blind. In France it is reported that 10 per cent. of this defect was found among the persons employed on the railroads. In Germany it is about 4 per cent. The examination for color blindness is now being carried on in all the employés of the railroads in Europe, so that the dangers from this one defect can be removed.

With this point in view I addressed a letter on the 2d of July last to the presidents of all the railroads centering in this city, upon the subject, desiring to examine their train hands.

I received prompt replies from all of those to whom I wrote excepting one (the Pennsylvania Railroad, who took no notice of my letter), placing their men at my disposition for examination. They had been noticing the different reports upon the subject from European files or cuttings that appeared from time to time in our newspapers, which caused them to be much interested in the matter.

I have up to this time examined the train hands of the Philadelphia, Wilmington and Baltimore, the Delaware, the North Pennsylvania, and the Bound Brook railroads, and have found 3.5 per cent. color blind, that is, those who mistake colors one for the other, etc., and 8.5 per cent. more, who although able to distinguish the colors are unable to tell the shades of colors—who shade badly—thus making 12 per cent. of those examined who are not quick and sharp in the noticing and distinction of all colors and shades thereof. But of this 12 per cent. only the 3.5 per cent. were of such a character of defect as to make them really incapable and unsafe to fill the positions they occupied.

In the examination of these men, several methods were used, so that there should be no mistake, and perhaps cause the removal of a reliable person from a responsible position, or the retention of one in whom there might be danger for the many unsuspecting travellers on the train.

The method of Prof. Holmgren, of Sweden, in testing with skeins of colored worsteds, was first placed before them; then that of Dr. Stilling, in which colored letters on a black card are displayed; after which plates of colored glass were held in front of a gas flame in a darkened room, and finally the different signal lamps used on the roads were brought before them in various ways.

The examinations were at first made in the evening by gaslight, and those found defective in the least were re-examined very carefully in daylight.

The refraction of the eyes was carefully examined with the ophthalmoscope, and vision taken, and of the number under examination 79.4 per cent. were emmetropic; 14 per cent. hypermetropic; 3.9 per cent. myopic; and 2.68 per cent. astigmatic.

Of the color blind 47.0 per cent. were emmetropic, 35.0 per cent. hypermetropic, 12.0 myopic, and 5.9 per cent. astigmatic. Of those who only shaded badly, 77.5 per cent. were emmetropic, 17.5 per cent. hypermetropic, 2.5 per cent. myopic, and 2.5 per cent. astigmatic.

It will by this be seen that color blindness is not governed by any defect of refraction. In cases of myopia when the vision was only $\frac{10}{c}$, all shades of color could be promptly and correctly distinguished at a distance of thrice the range of vision with the worsteds, and at a much greater distance with the signal lights.

Age has nothing to do with this anomaly, for those found defective in the least range from 20 to 53 years of age.

Of those defective 49.9 per cent. were green blind, 44.4 per cent. red, and 5.5 per cent. blue.

Of the 8.5 per cent. defective in shading, 95 per cent. were so in greens, and 5 per cent. in red. I have no doubt in the least that the cause of these being so defective in shading colors is the want of education. None had ever been placed in such a position or condition to handle and examine colors.

My attention was attracted to two peculiarities among those found color blind. One was the fact of two men who could not distinguish red from green on test, had educated themselves to know that red was an intense color, and thus distinguished bright red signals by their luminosity, but at the same time, bright greens and other bright colors were red to them, and for such said they would stop the trains; thus being on the safe side and never having an accident to occur to them. Green they called a deep or dull color, and dark reds, dark greens, and browns were all green to them, and they would pass them by as all right on the road, thus causing them to be unreliable in their positions.

The other was the power of distinguishing bright red when held within three feet of the eyes, while at 10, 20, and 30 feet it was invariably called green. In sorting the wools bright reds and light greens he picked out together for red. The acuity of vision was normal $\frac{20}{xx}$. In this case it appears that the retina was only affected

by the luminousness of the color when close to the eyes and not when held at a distance. This being a new feature in the perception of color, and fearing some error or deception, I carefully examined him several times and in different ways with the same result.

During the past winter I have examined, with the assistance of Drs. Thos. H. Fenton and Frank Fisher, the boys of the Keystone Grammar School to the number of 176, of whom 18 were defective, none, however, being really color blind, but all defective in shading. One called all dark shades of yellow, browns; with eight, purples were blue; two said that dark green was brownish; one took light browns for red; the rest shaded badly in greens.

It is just as necessary for sea-faring men to be free from this defect of color blindness as railroad men, to prevent the accidents of collision at night.

The Cunard Steamship Company has for many years examined their men by the display of colored lights at the longest possible distance, and a single error disqualifies the man for their service. All officers and soldiers should be thoroughly tested before placing them into the signal corps of the army, particularly in time of war.

Since these examinations have been made throughout Europe, several forms of the defect have been found, and Holmgren has divided them into three grades of intensity.

1. Total color blindness (*Totale Farbenblindheit*) (*Achromatopsia*). A condition in which there is entire absence of the perception of colors. Everything looks in black and white like a photograph. This grade is mostly acquired from some disease of the brain or optic nerve. It is very rarely congenital. Only 2 or 3 so found are recorded.

2. Complete color blindness (*Vollständige Farbenblindheit*) (*Partial Achromatopsia*). In which there fails the perception of one of the fundamental colors, red, green, or violet (blue). In this grade we can generally place the congenital cases.

There are many cases that may come under this grade which might have been improved by education; but one born color blind will always remain so, no matter how assiduously he attempts to educate his eye to distinguish by the intensity of the color. He will not be able to see it in the same way nor with the promptness of a normal eye. He does not really see the color, but the intensity of it. In this way the distinguishment of the colors is acquired by practice, but is not constant and very uncertain. Just as we have seen in the two cases mentioned previously, in which they failed to recognize red on test, but by practice and observation had learned to know a bright red by its intensity of color.

3. Incomplete color blindness (*Unvollständige Farbenblindheit*) (*Dyschromatopsia*). This form is more frequent, and consists in a reduced sensitiveness in recognizing one of the fundamental colors, particularly the shades of a color when the fundamental color may be perceived. The impression or perception is not so strong and clear in certain shades as in others. This grade of the defect can be very greatly remedied by education; and care should be taken to teach children all the colors and shades thereof.

I am pleased to know that the regular teaching of the distinguishment of colors has been introduced in our public schools, beginning in the lowest sections of the primary schools with the primary colors, red, yellow, blue, and advancing slowly and regularly with the colors and shades in the higher sections as the pupils are promoted.

Magnus, of Breslau, has added a fourth grade of this defect which he calls "Dulness or sluggishness of color distinction (*Farbenträgheit*). This is characterized by an individual in first sorting the colored wools, who lays many together of different shades as if color blind, but on looking at them again to see if he is correct notices

his mistake and then re-sorts them correctly. In such cases the color perception is normal but slow in comprehension.

While writing this report I had the good fortune to be able to test the suggestion of Javal for the cure of this defect in some cases by the use of a solution of fuchsine between thin plates of glass, and although skeptical upon the idea, I found that great improvement took place in its use in this following case:—

Chas. Stottmeister, æt. 45, came to me May the 14th, saying that although a dyer by trade and in business since boyhood, his father having a dye house in Germany, he was color blind and had been so from youth. He made the dyes according to the receipt furnished him, and until they looked like the sample to him; but at the same time he could not distinguish purple from blue. Reds on green or blue he could not see, that is red tinges in any color in which green or blue were combined. A gray-brown looked green to him. A lead is pink. A deep blue is purple. A clear brown and an olive-green are one color. He cannot see a red tinge in a mixture with yellow. Browns all have a green shade.

On several different occasions I have tested him by day and by night with a solution of fuchsine (1 gr. to the ounce of water), between two thin glass plates before the eyes, and invariably it corrects the defects. The colors become clearer, "all blues are bluer," browns are correct. He sees the red tinges in the shades which he could not see before, but knew they were there from the mixture in making the dyes. Purples and blues are distinct; the red in the purple being clearly defined. The difference between the brown and olive-green is distinctly seen. When red is on yellow, the red is brought out. Greens are more positive. Without the fuchsine all browns have a greenish cast, with the fuchsine the red comes out and the green fades away, showing clear brown. When there is no red in the color, the fuchsine does not cause such a shade over all the colors as it does in a normal eye.

This is a very clear and interesting case, as the man is a bright intelligent person; prompt in observation, and naturally interested in his situation, as it has prevented him holding most excellent places in dye houses.

The cause of this action in fuchsine has as yet not been explained; it arises perhaps from the power of polarization—in separating and absorbing certain chemical rays.

This correction by fuchsine, however, cannot be made by persons employed in railroad service; and I do not think it will be of benefit in many cases. While it brings out the red in colors it also destroys

the green, so that dark greens become almost black. Thus, as it might be said, correcting red blind and making green blind.

While preparing a pair of glasses with the fuchsine my friend Mr. W. Mitchell McAllister made a careful examination into the powers and properties of this liquid. He found that it entirely destroys or neutralizes most of the green shades in colors. The very dark shades it makes almost black, the medium brown, and affects very little the lighter shades. It adds red to all the other colors. Deepens the yellows. It has, however, no power of polarization. Its power is in the separating and absorbing of chemical rays. It is a hydrochlorate of aniline.

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